

FIRECLAY



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FIRECLAY

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**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES**

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20 Fireclay

The name fireclay is given to a group of refractory clays which can withstand temperatures above pyrometric cone equivalent (PCE) - 19. Refractoriness and plasticity are the two main properties needed in fireclay for its suitability in the manufacture of refractory bricks. A good fireclay should have a high fusion point (>1,580° C) and good plasticity. Fireclay containing high alumina and low iron oxide, lime, magnesia & alkalis is preferred by refractory manufacturers. The aluminous (kaolinitic) variety of fireclay is more refractory because of its hardness and density and absence of iron, giving it a white-burning colour. The absence of alkalis gives it a very high fusion temperature.

RESOURCES

India possesses substantial reserves of fireclay. The best deposits occur in association with the coal seams in the Lower Gondwana Coalfields of Andhra Pradesh, Jharkhand, West Bengal, Madhya Pradesh and Neyveli lignite fields in Tamil Nadu. Notable occurrences of fireclay, not associated with coal measures, are reported in Gujarat, Jabalpur region of Madhya Pradesh and Belpahar-Sundergarh areas of Odisha. The reserves of fireclay are substantial but reserves of high-grade (non-plastic) fireclay containing more than 37% alumina are limited.

Reserves and resources of fireclay as per UNFC system as on 1.4.2010 are estimated at 713.5 million tonnes. Out of these, 30.1 million tonnes are grouped under reserves category while the bulk, i.e., 683.4 million tonnes are classified under resources category. Out of 30.1 million tonnes reserves, 14.4 million tonnes are proved reserves and 15.7 million tonnes are probable reserves. Out of the total resources, Odisha accounts for 24% followed by Madhya Pradesh (17%), Tamil Nadu (16%), Jharkhand & Rajasthan (9% each) and Gujarat (8%). Gradewise, refractory-plastic grade accounts for 36% followed by refractory-unspecified (16%) and refractory-non-plastic/semi-plastic (15%). The remaining 33% are of others, unclassified and not-known grades (Table-1).

EXPLORATION & DEVELOPMENT

No exploration was carried out during the year 2013-14 by any Central/State govt. agencies.

PRODUCTION, STOCKS & PRICES

The production of fireclay at 707 thousand tonnes in 2013-14 decreased by 29% as compared to that in the previous year due to heavy rain, lack of demand and closure of some mines for environment clearance.

There were 52 reporting mines in 2013-14 as against 74 mines in the preceding year. Besides these principal mines, the production of fireclay was also reported as an associated mineral by 17 mines, which accounted for about 22% of the total production during the year 2013-14. Nine principal producers contributed 74% of the total production. Twenty four mines including 8 associated mines each producing more than 5,000 tonnes annually accounted for about 88% of the total production. Private sector mines reported 99% output of fireclay.

Rajasthan continued to occupy the first position among states with contribution of 44% followed by Tamil Nadu (23%), West Bengal (14%), Madhya Pradesh (7%), Gujarat (6%), Andhra Pradesh (4%), Karnataka (2%) and nominal production was reported from Maharashtra (Tables - 2 to 5).

The mine-head closing stock of fireclay for the year 2013-14 were 305 thousand tonnes as against 429 thousand tonnes in the previous year (Table - 6).

The average daily employment of labour during 2013-14 was 500 as against 777 in the preceding year. Domestic prices of fireclay are furnished in the General Review on 'Prices'.

MINING AND MARKETING

Practically, all the fireclay mines are worked manually. Most of the mines are small and worked by opencast method by forming benches in overburden and fireclay. Most of the refractory manufacturing units have their own captive mines.

The important marketing centres of fireclay are Mahuamilan and Balumath in Jharkhand, Than in Gujarat, Katni in Madhya Pradesh and Belpahar in Odisha. Water seepage beyond the depth of 6 m is the main problem commonly faced by most of the mine owners and as a result of which most of the mines are kept closed during rainy season.

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**Table – 1 : Reserves/Resources of Fireclay as on 1.4.2010
(By Grades/States)**

(In '000 tonnes)

Grade/State	Reserves				Remaining resources					Total resources (A+B)			
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332		Inferred STD333	Reconnaissance STD334	Total (B)
		STD121	STD122			STD221	STD222						
All India : Total	14,376	7,358	8,371	30,104	10,020	19,215	21,775	47,666	54,377	529,173	1,190	683,415	713,519
By Grades													
Refractory-non-plastic/semi-plastic	2,914	390	1,337	4,642	3,959	11,953	1,743	807	1,180	86,235	-	105,876	110,518
Refractory-plastic	2,801	1,165	1,253	5,220	719	3,656	2,934	4,241	4,527	238,860	232	255,168	260,388
Refractory-unspecified	7,240	3,990	4,945	16,175	4,743	3,208	5,244	1,115	2,658	79,233	-	96,201	112,377
Others	580	1,664	542	2,786	579	204	1,920	7,236	4,137	45,096	125	59,297	62,084
Unclassified	704	17	293	1,013	-	-	5,097	59	30	5,679	-	10,865	11,878
Not-known	137	132	-	268	20	195	4,837	34,206	41,845	74,070	833	156,006	156,275
By States													
Andhra Pradesh	548	647	381	1,576	50	735	1,314	56	908	18,444	132	21,638	23,214
Assam	-	-	-	-	-	-	-	-	-	3,161	-	3,161	3,161
Bihar	-	-	-	-	-	-	-	-	-	44	-	44	44
Chhattisgarh	-	23	12	35	-	27	-	7,180	3,400	10,336	-	20,942	20,978
Delhi	-	-	-	-	-	-	-	6	13	45	-	64	64
Gujarat	276	29	132	437	1,175	635	923	638	962	53,526	-	57,859	58,295
Jharkhand	828	-	775	1,602	12	479	125	-	249	64,151	-	65,017	66,619
Karnataka	95	324	85	503	792	595	6,871	-	226	5,250	-	13,734	14,238
Kerala	-	-	-	-	-	-	-	8,200	51	9,929	-	18,181	18,181
Madhya Pradesh	2,167	2,026	269	4,462	829	3,747	5,690	1,582	2,823	101,081	100	115,852	120,314
Maharashtra	244	-	388	632	-	-	-	-	-	6,850	-	6,850	7,482
Meghalaya	-	-	-	-	-	-	-	-	-	10,999	-	10,999	10,999
Odisha	581	278	52	911	2,135	11,280	3,774	26,185	42,747	83,045	-	169,166	170,076
Rajasthan	8,543	659	5,000	14,202	195	1,071	583	2,256	2,580	45,536	-	52,221	66,423
Tamil Nadu	322	3,269	423	4,014	4,833	171	1611	1,561	-	102,069	-	110,244	114,258
Tripura	-	-	-	-	-	-	-	1	-	369	-	370	370
Uttar Pradesh	-	-	-	-	-	-	-	-	-	3,221	-	3,221	3,221
West Bengal	771	104	854	1,729	-	476	883	-	419	11,115	958	13,852	15,581

Figures rounded off.

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Table – 2 : Principal Producers of Fireclay, 2013-14

Name & address of producer	Location of mine	
	State	District
Sampat Lal Daga, Labuji Ka Katla, 1 st Floor, Bagree Mohalla, Bikaner- 334 001, Rajasthan.	Rajasthan	Bikaner
A. Abdullah, No.10/108, North Street, T. Pottakollai.Z.Thathanur, Udayarpalayam- 621 804, Dist. Ariyalur, Tamil Nadu.	Tamil Nadu	Ariyalur
Saurabh Chandana, Rathkhana Colony, Bikaner- 334 001, Rajasthan.	Rajasthan	Bikaner
Prism Cements Ltd, 305, Laxmi Niwas Apartments, Ameerpet, Hyderabad- 500 016, Andhra Pradesh.	Tamil Nadu	Perambalur
Patelnagar Minerals & Industries (P) Ltd, 20-B,Abdul Hamid Street, (Formerly British India Street.) Kolkata- 700 069, West Bengal.	West Bengal	Birbhum

(Contd.)

Table - 2 (Concl.)

Name & address of producer	Location of mine	
	State	District
Firoz Musabhai Kaladiya, C/o Musabhai Ismailbhai, Kaladia, PO.Chotila, Fulwadi, Thangadh Road, Surendranagar-363 530, Gujarat.	Gujarat	Surendranagar
Sunder Lal Daga, Bagree Mohalla, Bikaner- 334 001, Rajasthan.	Rajasthan	Bikaner
Birbhum Kaolin & Allied Industries (P) Ltd, 19, Block-1, Pannajhill, Barrackpur Road, Barasat- 700 125, Dist. 24 Parganas North, West Bengal.	West Bengal	Birbhum
Smt. Arunachalam Saradha, 45, Malvai Road, Dalmiapuram, Lalgudi- 621 652, Dist. Tiruchirapalli, Tamil Nadu.	Tamil Nadu	Perambalur

Table – 3 : Production of Fireclay, 2011-12 to 2013-14(P)
(By States)

(Qty in tonnes; value in ₹'000)

State	2011-12		2012-13		2013-14(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	983155	158016	999925	182739	706639	159859
Andhra Pradesh	55578	10103	49478	10512	31686	7178
Chhattisgarh	3423	856	2570	643	-	-
Gujarat	120266	9338	86316	6602	39555	2842
Jharkhand	85819	14895	111594	17151	-	-
Karnataka	5184	1428	16307	10000	13966	7808
Madhya Pradesh	66823	7894	71226	12671	45852	9746
Maharashtra	9512	1284	7547	1132	4670	701
Rajasthan	447615	88291	410331	87771	313927	88028
Tamil Nadu	106512	15953	145468	19768	161479	25278
West Bengal	82423	7974	99088	16489	95504	18278

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Table – 4 : Production of Fireclay, 2012-13 and 2013-14 (P)
(By Sectors/States/Districts)

(Qty in tonnes; value in ₹'000)

State/District	2012-13			2013-14 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	74(24)	999925	182739	52(17)	706639	159859
Public Sector	1(1)	6793	3297	1(1)	5917	3545
Private Sector	73(23)	993132	179442	51(16)	700722	156314
Andhra Pradesh	15(2)	49478	10512	10(1)	31686	7178
East Godavari	12(2)	42098	8244	7(1)	27746	5615
West Godavari	3	7380	2268	3	3940	1563
Chhattisgarh	1	2570	643	-	-	-
Korba	1	2570	643	-	-	-
Gujarat	9(1)	86316	6602	6	39555	2842
Kachchh	2(1)	660	73	2	650	111
Rajkot	1	45867	3256	-	-	-
Surendranagar	6	39789	3273	4	38905	2731
Jharkhand	7	111594	17151	-	-	-
Dhanbad	1	295	47	-	-	-
Latehar	5	83699	13792	-	-	-
Palamu	1	27600	3312	-	-	-
Karnataka	1(1)	16307	10000	1(1)	13966	7808
Hassan	(1)	4307	2800	(1)	3936	3149
Tumkur	1	12000	7200	1	10030	4659
Madhya Pradesh	8(6)	71226	12671	9(5)	45852	9746
Jabalpur	1(1)	12791	1787	1(1)	3413	390
Katni	4(2)	37746	5160	5(3)	27758	4243
Satna	(2)	12090	4836	(1)	7564	4401
Sidhi	(1)	93	37	-	-	-
Umariya	3	8506	851	3	7117	712
Maharashtra	1	7547	1132	1	4670	701
Amravati	1	7547	1132	1	4670	701
Rajasthan	10(2)	410331	87771	11(2)	313927	88028
Bikaner	10(2)	410331	87771	11(2)	313927	88028
Tamil Nadu	16(3)	145468	19768	8(2)	161479	25278
Ariyalur	4	90185	9510	1	74900	9887
Cuddalore	3	25817	4016	3	4661	851
Perambalur	8(1)	28941	6174	4	63805	12125
Tiruchirapalli	1(2)	525	68	(2)	18113	2415
West Bengal	6(9)	99088	16489	6(6)	95504	18278
Bankura	4(2)	32757	4962	4(1)	12541	3326
Birbhum	2(7)	66331	11527	2(5)	82963	14952

Figures in parentheses indicate associated mines of ball clay, bauxite, clay (others), laterite and kaolin.

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Table – 5 : Production of Fireclay, 2012-13 and 2013-14 (P)
(By Frequency Groups)

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage in total production		Cumulative percentage	
	2012-13	2013-14(P)	2012-13	2013-14(P)	2012-13	2013-14(P)	2012-13	2013-14(P)
	All Groups	74(24)	52(17)	999925	706639	100.00	100.00	-
Up to 1000	21(8)	15(1)	7493	3995	0.75	0.57	0.75	0.57
1001 to 5000	24(9)	21(8)	95845	77846	9.59	11.02	10.34	11.59
5001 to 10000	8(3)	5(4)	78141	59037	7.81	8.35	18.15	19.94
10001 & Above	21(4)	11(4)	818446	565761	81.85	80.06	100.00	100.00

Figures in parentheses indicate the number of associated mines with ball clay, bauxite, clay (others), kaolin and laterite.

Table – 6 : Mine-head Stocks of Fireclay, 2012-13 & 2013-14(P)
(By States)

(In tonnes)

State	2012-13	2013-14
India	428683	304745
Andhra Pradesh	2436	1826
Chhattisgarh	26957	24256
Gujarat	7522	5940
Jharkhand	80878	78771
Karnataka	11745	10153
Madhya Pradesh	37992	21165
Maharashtra	35	35
Odisha	1011	4
Rajasthan	186002	112269
Tamil Nadu	18032	22466
West Bengal	56073	27860

USES AND SPECIFICATIONS

Fireclays are used in the manufacture of bricks, blocks, retorts, crucibles, mortars, masses, pottery, floor tiles, etc. Low-grade material is used for manufacturing heavy sanitaryware, such as, pipes and bath tubs. Firebricks are used where heat generation is involved. Firebricks are used extensively in furnaces, kilns and ovens. Firebricks are required chiefly by metallurgical industries.

The fireclays are graded into: i) low duty ii) intermediate duty iii) high duty and iv) super duty, depending upon their capacity to withstand high temperature before melting. The low duty fireclay can withstand temperatures between 1,515 and 1,615°C (PCE 19-28); intermediate duty fireclay up to 1,650°C (PCE 30), high duty fireclay up to 1,700°C (PCE 32) and super duty beyond 1,775°C (PCE 35).

BIS has not standardised any specifications for fireclay. However, the erstwhile Director General of Technical Development Sub-committee on Refractory Raw Materials had recommended specifications as given in Table-7.

The Expert Group on Classification of Minerals with regard to their Possible Optimum Industrial Use had recommended the following end-use classification of fireclay for Refractory Industry:

Type	Constituent		
	Al ₂ O ₃	Fe ₂ O ₃	PCE (orton)
Non-plastic/ semi-plastic	30% (min)	2% (max)	30 (min)
Plastic	18% (min)	3% (max)	18 (min)

Table – 7 : Specifications of Plastic and Non-plastic Fireclays

Grade	Constituent		
	Al ₂ O ₃	Fe ₂ O ₃	PCE (orton)
i) Non-plastic/Semi-plastic Fireclay			
Grade-I	35-40%	1.0% max	33 min
Grade-II	32-35%	1.0-1.5% max	32 min
Grade-III	30-32%	1.5-2.0% max	30 min
ii) Plastic Fireclay			
Grade-I	30-32%	1.0-1.5%	30 min
Grade-II	28-30%	2.0-3.0%	28 min
Grade-III	22-28%	1.0-2.0%	26 min
Grade-IV	18-20%	1.5-2.0%	18-21 min

Crude fireclay and other clays including kaolin (china clay) are also used in a few cement manufacturing plants to increase the alumina content in the raw meal and its plasticity.

CONSUMPTION

The total consumption of fireclay increased from 493,600 tonnes in 2012-13 to 536,400 tonnes in 2013-14. Cement Industry was a major consumer of crude fireclay accounting for about 55% consumption in 2013-14, followed by refractory (34%), ceramic (8%) and iron & steel (2%) industries. The remaining 1% was consumed in other industries, i.e. pesticide, alloy steel, graphite products, foundry, sugar, etc. (Table- 8).

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**Table- 8: Consumption* of Fireclay
2011-12 to 2013-14
(By Industries)**

Industry	(In tonnes)		
	2011-12	2012-13(R)	2013-14(P)
All Industries	516400	493600	536400
Alloy steel	500(9)	500(9)	500(9)
Cement	275800(4)	252800(4)	293500(4)
Ceramic	43700(13)	44200(13)	44200(13)
Foundry	200(23)	200(23)	200(23)
Graphite products	1100(18)	1200(18)	1300(18)
Iron & steel	10500(6)	10500(6)	10500(6)
Pesticides	2900(2)	2900(2)	2900(2)
Refractory	181500(42)	181100(44)	183100(44)
Sugar	100(27)	100(27)	100(27)
Others (abrasive, glass, paper, textile, and vanaspati)	100 (21)	100(21)	100(21)

Figures rounded off.

Figures in parentheses denote the number of units in organised sector.

(* includes actual reported consumption and/or estimates made wherever required).

FOREIGN TRADE

Exports

The exports of fireclay decreased drastically to 2,100 tonnes in 2013-14 from 36,148 tonnes in 2012-13. Exports were mainly to Bangladesh (20%), Senegal (10%), Nepal (15%), Sri Lanka (9%), Rwanda and Norway (7% each). Exports of refractory bricks considerably decreased to 213 thousand tonnes in 2013-14 from 331 thousand tonnes in 2012-13. Exports were mainly to Turkey (15%), Saudi Arabia (5%), UK and UAE (4% each), Indonesia, Iran & Bangladesh (2% each) (Tables- 9 & 10).

Imports

Imports of fireclay in 2013-14 decreased drastically to 146 tonnes from 1,610 tonnes in the previous year. Imports were mainly from China (75%), Turkey (12%) and U K (9%). Imports of refractory bricks decreased drastically to 272 thousand tonnes in 2013-14 from 384 thousand tonnes in the previous year. The share of imports from China was 83% which was followed by Germany (6%), Austria (4%) (Tables- 11 & 12).

**Table- 9: Exports of Fireclay
(By Countries)**

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	36148	58678	2100	16879
Ethiopia	216	820	120	4702
Nepal	216	2432	309	2776
Bangladesh	3884	7637	426	1060
Norway	80	428	140	982
Rwanda	-	-	157	962
Kenya	159	817	91	928
Mauritius	6	38	55	810
UAE	84	178	60	780
Sri Lanka	66	400	181	631
Senegal	13	32	205	500
Other countries	31424	45896	356	2748

**Table – 10 : Exports of Refractory Bricks
(By Countries)**

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	330660	6330676	213394	6212776
Italy	846	83824	3088	359553
USA	831	92006	2996	349541
Turkey	12834	568824	31073	296599
UK	11510	290068	7501	246796
Saudi Arabia	12559	264613	10388	222817
Indonesia	10477	361817	4537	202318
Iran	8005	302985	4287	192797
UAE	9788	198901	9392	192577
Russia	1593	101234	2280	180504
Bangladesh	3079	111589	4054	157740
Other countries	259138	3954815	133798	3811534

**Table- 11: Imports of Fireclay
(By Countries)**

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1610	22423	146	4473
China	1576	21750	110	3370
UK	-	-	13	611
Turkey	18	280	17	311
Denmark	-	-	2	91
USA	15	310	4	69
Australia	-	-	++	21
Other countries	1	83	-	-

**Table – 12 : Imports of Refractory Bricks
(By Countries)**

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	384234	15855045	272306	15304944
China	329015	12108721	224782	11377919
Germany	24229	1819853	17092	1592072
Austria	10805	768052	10142	850732
France	1886	170564	4866	418078
Japan	608	71892	2852	162071
Italy	1380	137316	1732	160298
Turkey	2376	139287	2067	140805
Chinese Taipei/ Taiwan	351	20740	987	98059
Spain	1009	78504	864	79950
Belgium	110	7449	771	72023
Other countries	12465	532667	6151	352937

FUTURE OUTLOOK

Fireclay is one of the most important minerals used in the Refractory Industry. Almost the entire production in the country is consumed in the manufacture of refractories and about 80% of these refractories are used by the Iron & Steel Industry. India has huge reserves of fireclay and there does not seem to be any problem in respect of supplies to the Refractory Industry in the near future. However, a serious dearth is being felt in the availability of high-grade fireclay analysing 37% and above Al_2O_3 with Fe_2O_3 and fluxing impurities less than 2% for supply to the Refractories. To fulfil the increasing demand of the Refractory Industry, it is imperative that deposits of high-grade fireclay be explored and delineated.

The export prospect of fireclay is relatively less as it is considered as low-value high bulk mineral. However, fireclay bricks as a commodity could have high export potential and therefore must be encouraged.

As per the Sub-Group-II Report for 12th five year plan, the apparent domestic demand of fireclay was estimated at 739 thousand tonnes by 2016-17 at 9% growth rate.